

collimator was rotated with the isocenter set to C-spine level 2. The divergence of the upper spinal field was aligned with the junction of the cranial field; the couch was rotated 270° and the gantry was rotated to align the divergence of the lower spinal field with the inferior border of the upper spinal field. To confirm the junction of the treated field: 1) an image plate (14×17 inches) was placed vertically on the couch so that the junction of the cranial field and the upper spinal field would be included in the plate; 2) the cranial field was irradiated to check it; 3) the lateral lock of the couch was released and the isocenter was moved to the image plate before irradiation to check the upper spinal field; and 4) the junction of the cranial field and the upper spinal field was analyzed with a computed radiography reader (CAPSULA XLII, Fujifilm, Japan). The field junction was photographed three times to confirm its accuracy and reproducibility. Two-millimeter or smaller gaps or overlaps were considered setup error. If a 2 mm or greater error was specifically reproduced, the center was moved again through 2D simulation.

**Results:** The junction of two fields could be confirmed regardless of the degree of enlargement according to the distance between the cranial isocenter and the image plate, with the cranial field as the half beam. The verification images of the 20 patients were measured with a computed radiography reader. Eighteen patients showed a setup error that was smaller than 2 mm, and the center was moved again for two patients who showed the specific reproduction of a gap or overlap of 2 mm or more at the junction. Since the divergences of the upper spinal field and lower spinal field were aligned at the body of the patient and the bottom of the couch, the junction was confirmed by the naked eye by attaching paper to the bottom of the couch.

**Conclusion:** For craniospinal irradiation patients, treatment in the supine position rather than in the prone position is advantageous for setup stability and airway security. The proposed technique can maintain the homogeneity of the dose because it can accurately confirm the junction of the fields using an image plate.

#### EP-2110

**A study of prostatic calculi: in patients receiving radical radiotherapy for prostate cancer**

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**Purpose or Objective:** Image guided Radiotherapy (IGRT) for prostate cancer (PCA) frequently employs surgically implanted fiducial markers. It is estimated that up to 35% of prostate radiotherapy patient have prostatic calculi (PC) visible on treatment cone beam CT (CBCT). Prostatic calculi present a potential alternative to implanted fiducials. The purpose of this study was to establish the incidence and location of PC in a contemporary population of prostate radiotherapy patients.

**Material and Methods:** A retrospective single-observer analysis of images from patients with PCA who received RT at our centre was undertaken to identify PCs within the prostate. The Prostate Imaging and Reporting Data System (PI-RADS) graphical schema was used to record the position of PC. Available images from Trans-rectal Ultra-sound (TRUS) brachytherapy volume study scans, CT scans and CBCT scans were analysed from 242 patients.

**Results:** In total, 394 scan sets from 242 patients were analysed. 57 out of 62 (91%) TRUS images and 153 of 180 (85%) CT planning scans had visible PC. Of the 153 patients

with PC visible on CT, 136 also had CBCT scans. All but 1 had corresponding PC on CBCT. 16 TRUS scans had corresponding PCs visible on CT scans but seed artefact obscured visibility in most cases. PC were most frequently observed in sections 3p and 9p (poster of mid gland and apex) of the PI-RADS schema and least often observed in 8a, 12a & 13a (anterior base and apex).

**Conclusion:** In our series, a significant majority of the prostate radiotherapy patient population have PC detectable on pre-radiotherapy imaging. A prospective clinical trial will commence shortly investigating the feasibility of using PC as an alternative to FMs.

#### EP-2111

**Inter-observer variability in stereotactic IGRT with CBCT: is a CTV-PTV margin needed?**

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**Purpose or Objective:** Use of image guided radiotherapy (IGRT) allows to reduce uncertainty margin from clinical to planning target volume due to better geometric accuracy. Geometric accuracy of Linac-based stereotactic IGRT is reported to be within 2-3 mm and Kilo-voltage cone beam computed tomography (Kv-CBCT) is generally considered as the gold standard for treatment verification. However inter/intra-observer variability in image evaluation may exist. Aim of this report was to conduct a preliminary analysis to quantitatively determine the magnitudes of such inter-observer variations

**Material and Methods:** Kv-CBCT images were obtained for all patients who underwent stereotactic radiotherapy treatments. They were analyzed both on-line (before treatment delivery) and off-line by two different Radiation Oncologists (RO, M.M. and V.M.) with at least one year of experience in CBCT images verification. Translational displacements in anteroposterior (z), mediolateral (x), and craniocaudal (y) directions were recorded for all verifications and discrepancies between the two RO were calculated. Based on the discrepancies in x, y, and z directions, systematic and random differences were calculated and three-dimensional radial displacement vector was determined. Systematic and random differences were used to derive CTV to PTV margin. Time spent for on-line image verification was also recorded. Results are reported as mean values. The T test was used to assess differences between groups

**Results:** From January to September 2015, 189 CBCT scans of 48 patients submitted to intracranial (39 scans) or extracranial (150 scans) Linac-based stereotactic radiotherapy were analyzed. An inter-observer discrepancy of  $\pm 3$  mm on at least one direction was observed in 37 CBCT scans (19.6%). Mean radial discrepancy was 1.82 mm (range 0-11.1 mm). In AP, CC and ML directions, systematic differences were 0.89, 1.87, and 0.67 mm and random discrepancies were 0.43, 0.55, and 0.50 mm, respectively. By van Herk's formula CTV-PTV margins needed to account for such inter-observer variability were 2.5, 5.0 and 2.0 mm in AP, CC and ML directions, respectively. Inter-observer discrepancies were smaller for intracranial than extracranial stereotactic treatment (mean radial discrepancy 1.2 versus 1.9 mm, respectively p=0.01). On-line verification of CBCT took a mean time of 4 minute and 14 seconds (range 58 sec - 12 min 25 sec). No significant difference in magnitudes of inter-observer variability was observed according to time spent for verification

**Conclusion:** When using KV-CBCT for set-up verification in stereotactic treatment a large inter-observer variability can be seen in a significant proportion of scans, particularly in extracranial treatment. Such a difference may have an impact on target coverage or organ at risk irradiation, thus requiring a proper margin. Further evaluation is needed, particularly focusing on methods to decrease such inter-observer variability

#### EP-2112

**Intrafraction setup errors in single fraction stereotactic radiosurgery with Elekta Fraxion system**

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**Purpose or Objective:** Frame-based stereotactic radiosurgery (SRS) using rigid immobilization with head ring continues to be the standard treatment when it comes to intracranial SRS. We wanted to assess setup accuracy and intrafraction errors of patients treated with single fraction intracranial stereotactic radiosurgery using the Elekta Fraxion® immobilization system (Frameless SRS) and HexaPOD positioning platform (translational and rotational set up error).

**Material and Methods:** 5 patients with a diagnosis of brain metastasis were treated with single fraction frameless stereotactic radiosurgery (SRS) at our institution between April 2015 and September 2015. Patients were initially immobilized using Fraxion® immobilization system (Fraxion comprises a head frame with a mouth-bite, thermoplastic mask and vacuum occipital cushions) and HexaPOD couch platform (HexaPOD™ is a robotic patient positioning platform providing six degrees of positioning freedom). Cone-Beam computed tomography (CBCT) were acquired before and after treatment to assess for intrafraction set up errors. Translational and rotational set up errors were obtained in Right/Left (R.L.), Postero/Anterior (P.A.), Inferior/Superior (I.S.) directions. Means and one standard deviation of the intrafractional errors in all six directions were analyzed.

**Results:** A total of 10 images were analyzed. A summary of the means and one standard deviation of the intrafractional errors (in mm for translation and degrees for rotation) were  $0.01 \pm 0.10$  (RL),  $0.00 \pm 0.20$  (PA),  $0.04 \pm 0.10$  (IS),  $-0.76 \pm 0.80$  (RL rot.),  $-0.02 \pm 0.81$  (PA rot),  $0.58 \pm 0.97$  (IS rot) All of the patients were within the intrafractional errors described as for frame-based SRS.

**Conclusion:** Single fraction intracranial stereotactic radiosurgery utilizing frameless immobilization system like Elekta Fraxion® and HexaPOD® Platform it's a secure, precise and reproducible technique. Comparable results with Frame-based SRS were obtained, keeping between 1 mm and 1 degree margin range.

#### EP-2113

**Clinical implementation of an optical surface monitoring system (OSMS®, Varian) in breast irradiation**

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**Purpose or Objective:** The optical surface monitoring system (OSMS®) was implemented in our clinic to improve our daily radiation therapy workflow, to avoid frequent repositioning and unnecessary skin marks on breast cancer patients.

**Material and Methods:** 6 breast cancer patients were positioned with OSMS® and the set-up was then compared with MV imaging. The patients were treated using 3D

tangential fields with free breathing and were positioned on the breast board. The OSMS cameras acquired the patient's positioning in 2D and a computer algorithm reconstructed the image in 3D. Prior to that, the patient's reference surface was imported from the planning CT scan and the region of interest within the treated area was selected. For the positioning with OSMS® the breast, hips and part of the upper arm on the treated side were used as a region of interest (ROI). After aligning the patient, MV imaging and bone match on the chest wall was used to correct for positioning error. 2 patients were aligned according to the CT skin reference marks previous to positioning with OSMS®. The other 4 patients were directly set up with OSMS. We compared this data with previously collected data on the difference between positioning, based on the skin marks of the patient using a laser system and MV imaging.

**Results:** The most suitable ROI was found to be the irradiated breast itself, excluding the shoulder and clavicular region, but including a 2 cm margin of chest wall surrounding the breast. Positioning based on OSMS® was in good agreement with the positioning based on MV imaging. The mean deviation between the two techniques was  $1.3 \pm 1.6$  mm,  $1.3 \pm 1.8$  mm and  $0.8 \pm 0.8$  mm in vertical, longitudinal and lateral directions for the all 6 patients. This was superior to positioning based on patient skin marks alone ( $1.4 \pm 1.4$ ,  $1.8 \pm 2.8$  and  $1.7 \pm 1.1$  mm). The corrections of patient rotations were difficult to perform with OSMS®. Out of 112 treated fractions, 15 fractions showed on the MV image a rotation which was out of clinical tolerance and the patients had to be repositioned.

**Conclusion:** According to our preliminary data-patient positioning based on OSMS® is easy, time efficient and reproducible. Additionally, patient skin marks can be avoided. More data will be collected to confirm these findings. In the future we plan to use the OSMS® system for deep inspiration breath hold techniques and the set-up of extremities and bolus.

#### EP-2114

**3D-Transabdominal Ultrasound and ConeBeam-CT: comparison of prostate positioning**

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**Purpose or Objective:** External beam radiotherapy (EBRT) is a mainstay therapeutic option for prostate cancer and hypofractionated schedules were proposed as a suitable approach. Image guidance procedures are strongly needed to provide adequate accuracy precision, minimize geometric uncertainties and further diminishing unintended normal tissue irradiation. The Elekta Clarity™ platform allows the acquisition of three-dimensional ultrasound scans (3DUS) of the pelvic regions to perform image-guided radiotherapy. In our department, 3DUS is the reference IGRT modality and is used into daily clinical practice for prostate cancer radiotherapy (since from 2009) with optimal clinical results in terms of biochemical control and a good toxicity profile on 160 patients. Moreover 3DUS is a non invasive method with avoidance of extra radiation. In this study 3DUS was compared to grey-based positioning in kilovoltage Cone-Beam Computed Tomography (CBCT) during radiotherapy sessions.

**Material and Methods:** 10 patients affected with organ-confined prostate cancer were included. All patients should have a reliable ultrasound visualization of the prostate gland within the Clarity Platform. All patients received 61.1 Gy/26 fractions to the prostate gland and seminal vesicles and 70.2 Gy/26 fractions to the only prostate gland. The prostate positioning was controlled by 3DUS and CBCT. Patients were aligned to skin marks before all of the 260 treatment sessions. Control of the remaining inter-fractional setup error by 3DUS was successfully employed 147 times. During the